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ABSTRACT

A needs assessment questionnaire submitted to 180 elementary school teachers found that a majority of the teachers felt inadequate and unable to teach science. A majority of the teachers agreed that science should be an integral part of elementary education, that teachers should improve their knowledge of science, and that teachers would teach more science if they could update their knowledge in science content. The National Science Foundation provided funding for a one year program to instruct 48 teachers in environmental science education. The program's goals were to improve knowledge, to aid teachers in the use of environmental science education resources, and to develop cooperation and program support between scientists at a local university and the teachers. To understand the effects of the program and to measure its success, a study was designed to evaluate data from program participants. Data were collected using a Stages of Concern questionnaire and an Environmental Education questionnaire. Individual profiles of two teachers in the program were also analyzed. Results revealed that the attitudes of the teachers who participated in the program changed significantly as compared to a set of control group teachers. The two questionnaires proved to be useful instruments for identifying change in teachers in a specific and definite manner. Implications for inservice programs and future research are presented. (CJ)

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A CASE STUDY OF CHANGE: INSERVICE TEACHERS IN A NATIONAL SCIENCE FOUNDATION ENVIRONMENTAL SCIENCE EDUCATION PROGRAM

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ABSTRACT

A primary goal of staff development is change; staff development activities are designed to bring about change in its participants. How can such change be measured quantitatively?

This paper presents the results of a one year long staff development effort designed to respond to the needs of teachers in elementary schools involved in an environmental science education program. It reports the assessment procedure utilized for determining the need for inservice, describes the experimental techniques undertaken, describes the tools used for obtaining data, and reports the results of the effectiveness of a staff development program on teacher change.

A CASE STUDY OF CHANGE: INSERVICE TEACHERS IN A NATIONAL SCIENCE FOUNDATION ENVIRONMENTAL SCIENCE EDUCATION PROGRAM[1]

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and

Shirley M. Hord

INTRODUCTION

A primary goal of staff development is change (Harris, 1980). Though staff development activities are directed at inservice participants' specific needs in the knowledge and/or skill areas, how do we know if change has occurred? If there is change, how much? Typically, staff development is assessed by obtaining a "happiness coefficient" related to the inservice session from those who were involved. Staff developers have been interested in identifying and using assessment instruments tools which would provide more quantitative data related to change. Such assessment tools have been sought for use in summative evaluation and also for formative evaluation so as to furnish data which might be useful for decision making in the ongoing design of inservice.

The National Science Foundation (NSF) has as one of its functions the improvement of science at the pre-college level, that is, science taught in grades K-12. To this end the Pre-College Teacher Development in Science Program was initiated in 1959. The program is presently funded at the rate of 7.5

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[1]Work reported herein was conducted with the support of the National Science Foundation and the National Institute of Education. The opinions expressed are those of the authors and no endorsement by the National Science Foundation or National Institute of Education is implied.

million dollars per year. This money is distributed nation-wide to both two- and four year institutions, as well as to teaching centers and other state educational organizations.

The Science Education Center at The University of Texas at Austin consists of faculty and staff members whose objectives are: (1) to develop and continue research in the field of science education, (2) to provide aid for teachers already in service, and (3) to promote and maintain a strong undergraduate program for prospective science teachers. To these ends, laboratories equipped for science teaching and learning are maintained.

The Center was organized in 1959 through joint efforts of leaders in the Department of Curriculum and Instruction of the College of Education and the science departments of the College of Natural Sciences. The center's activities extend beyond the College of Education to include cooperative efforts with scientists across the entire university and other institutions, as well as teachers and administrators in both elementary and secondary schools.

Needs Assessment

Historically, science has not been given equal time in the elementary school curriculum as compared with reading, mathematics, language arts, and social studies. And yet, a primary objective of science education is the development of scientifically literate citizens. A recent report by the National Science Foundation has documented very carefully the omission of science from the elementary school curriculum. The trend is a national one and it is pervasive throughout the nation.

A study was undertaken in the central Texas region to determine how much science was being taught in elementary schools during 1979 and if that amount might be increased in 1980. A large sample of schools (N=42) were randomly

chosen for the study. A total of 227 day-long observations were conducted: Each observation began at the start of the school day and ended when pupils left. A startling discovery was made as a result of the observations. It was found that on the average, two percent (2%) of the total school day was devoted specifically to science instruction. This percentage is based on a school day of 6-1/2 hours. Translated into hours and minutes this percentage is equivalent to only seven minutes! At the same time there were several classes in which no science was taught at all!

In order to find out why more science was not being taught in elementary and middle schools a needs assessment was conducted during the 1978-79 school year. A teacher questionnaire was developed and then randomly distributed to teachers in the intermediate grades (grades 4, 5, 6). In addition, school principals, area coordinators, and school superintendents were contacted. State agencies such as the Texas Education Agency (TEA) and the Region XIII Service Center were included in the survey to gain suggestions, ideas, and support. Out of 180 questionnaires sent to twenty randomly selected schools in the central Texas region, 92% or 165 replies were received. A majority of the teachers (147 or 89%) felt inadequate and unable to teach science. Many (157 or 95%) wrote that they lacked adequate science background and experience in presenting science concepts. Some (71 or 43%) expressed a desire to go back to school and learn more science "if only we had an opportunity to do so." These statements expressed by the teachers sampled are not surprising when it is revealed that teachers completing their certification program in college are required to take only three to six hours of science.

A majority (123 or 75%) of the teachers surveyed agreed with the following statements: Science should play an integral part in the education of upper elementary and middle school pupils; intermediate elementary school teachers

should be concerned about improving their knowledge of science content; they would teach more science if they could update their background knowledge and experience in science content. In addition, the teachers (135 or 82%) voiced an interest in learning more about energy education, conservation, ecology, use of natural resources, food and population problems, plants and animals in their natural environment, and pollution.

On the basis of the findings from the needs assessment a proposal was submitted to the NSF Pre-College Teacher Development in Science Program in order to respond to some of the needs expressed by the teachers. The proposal was reviewed with the faculty of the Science Education Center, members of the scientific community, curriculum consultants from Region XIII Education Service Center, administrators, members of the Texas Education Agency Directorate for Science, and most importantly, inservice teachers.

NSF provided funding for one year in order to instruct 48 inservice teachers in environmental science education. It was felt that the program would be an excellent means for addressing the needs expressed by the teachers and at the same time would increase both the quality and quantity of science taught in the schools. This paper will briefly describe the environmental science education staff development program, also the participants of the program. The research methods and techniques undertaken to study change in the program participants will be reported. Then the results and findings of the inservice research study will be presented. Finally, implications of the findings for inservice education will be suggested.

INSERVICE PROGRAM

Based upon the objectives of NSF and the needs expressed in the survey,

the following objectives were identified for the environmental science education program:

1. To improve the knowledge of intermediate elementary and middle school teachers in grades 4-6 from the central Texas region in Environmental Science.

2. To aid teachers in the identification and use of environmental science education resources appropriate to their level of instruction, which would aid in the teaching of environmental science concepts.

3. To develop and maintain cooperation, communication, and program support between scientists at The University of Texas at Austin and intermediate elementary and middle school teachers in the central Texas region.

The needs assessment revealed that teachers were very much interested in environment-related concepts. They expressed interest in such topics as ecosystems, environments, minerals and rocks, air pollution, water pollution, communities, energy, and conservation. Therefore, these topics were included in the course content along with environmental law, geology of the Southwest and land management.

There were a total of 32 class sessions in the program. Participants attended all classes, each of which were 2-1/2 hours long. The lectures, demonstrations, and seminars usually required 75 minutes. The laboratory sessions lasted for 60 minutes followed by a 15-20 minute post-lab discussion to bring closure to the session and to clarify questions raised by the participants.

The materials and learning activities utilized in the class sessions were developed by the project director, inservice teachers, Texas Education Agency personnel, and members of the university's multidisciplinary faculty who served as resource personnel, including:

1. a biologist
2. a geologist
3. a botanist
4. an environmental chemist
5. an ecologist
6. a science educator
7. an environmental geologist

To enhance the instructional program, university scientists having expertise in many of the program topics were invited to present mini-lectures for the participants. The purpose for having the scientists was two-fold: (1) to present the latest in environmental science knowledge and technology, and (2) to introduce university scientists who could serve as future resource persons to the participants and their environmental science education programs conducted in the schools.

In order to provide program activities and materials that would be more relevant for the teachers, the data, which were collected as a measure of change in participants for summative evaluation purposes, were also used as formative feedback to the program director. The data made it possible to better understand and respond to participants' needs as they experienced the inservice change process. Thus, program modifications were designed and targeted toward the changing concerns of the teachers.

During the course of the program two week-end field trips were made. The first of these was a collecting trip in the fall. The trip covered the central Texas region. The focus of this trip was the geology of the region. Participants collected and identified rocks and minerals which would be used later in a rock study lesson.

A field trip was conducted again during the spring semester, to a state park. In addition to oserving the flora and fauna of the park, activities from an outdoor biology program were used by program participants. These activities were taken from the Outdoor Biology Instructional Strategies program designed specifically to be used with children in grades 4, 5, and 6. A complete list of

the flora and fauna observed in the park was made for later distribution to all participants. The list could be used by the teachers with their classes when participating in future field trips.

A unique aspect of the program was the conducting of inservice workshops by the participants for other teachers in their respective schools and school systems. This was referred to as the "multiplier" effect. The overall purpose was for the participants to share their knowledge and expertise not only with their pupils but with their colleagues and, ultimately, colleagues' students. In this manner the cost-effectiveness of the NSF environmental science education program would be enhanced in terms of the number of people involved with the total program. The number of workshops given by the participants was 35 which were attended by an average of 25 inservice teachers each, reaching 875 teach- ers. If each teacher worked with an average of 27 students, then a total of approximately 23,625 students would be exposed to science instruction and in particular environmental science education.

Participants

In order to secure applicants, program notices were sent to neighboring school districts within 75 miles of the university. In addition to direct mailings, information was distributed through state science teachers' newsletters, the Texas Education Agency, and regional education service centers.

Applicants expressing an interest in the program were required to return an application and two letters of support--one from an administrator supporting the teacher and one from a teaching colleague. Teachers were selected on the basis of the following criteria:

1. Receipt of application and supporting letters of recommendation
2. At least two years of teaching experience in grades 4-6

3. Selection without reference to sex, race, creed, national origin, or age
4. Minimum of 3 to 6 hours of undergraduate science courses
5. Teaching assignment in intermediate elementary grade or middle school (grades 4-6)

Forty-four inservice teachers were chosen from the central Texas region to participate in the environmental science education program. The final group of applicants chosen had an average of 4.6 years of teaching experience, an average age of 27.5 years, and an average of 5.1 semester hours of undergraduate science.

RESEARCH METHODS AND TECHNIQUES

In order to understand the effects of the inservice program and to realize the measure of its success, a study was designed to obtain formative and summative evaluation data from program participants. In this way, results from ongoing data collection could be used as a diagnostic basis for instituting changes, thus insuring the refinement of the program to meet the immediate needs of the teachers.

Instrumentation

Two instruments were selected to provide data. In order to determine teachers' concerns about the innovative science program and how concerns might change as a result of the inservice program, the Stages of Concern Questionnaire (SoCQ) was selected. Second, to measure teachers' attitudes toward science and how they might be affected by the staff development intervention, the Environmental Education Questionnaire (EEQ) was chosen. The underlying concepts and assessment tools for these two measures are describe below.

Stages of Concern Questionnaire. As a result of four years of engaging in research on change in schools and colleges, the Concerns-Based Adoption Model (CBAM), an important conceptual framework useful in understanding, monitoring and facilitating change in individual teachers was developed at the Research and Development Center for Teacher Education at The University of Texas at Austin. The CBAM offers a unique approach to the study of teacher change by focusing on the needs and describing the growth of individuals over time; it describes teachers as they first begin and then gain more experience with educational innovations. One of the dimensions of this model is Stages of Concern (SoC) (Hall, George & Rutherford, 1977), a conceptualization of the way the concerns of individual teachers change as they become familiar with and involved with new programs, processes or educational practices in their schools.

By concern is meant the feelings, attitudes, thoughts, ideas, or reactions an individual has related to a new practice. The work of Frances Fuller (1969) focused on the concerns of teachers-in-training as they progressed from early experiences in preservice teacher education programs to being experienced in-service teachers. This sequence of teacher concerns Fuller Labelled as unrelated, self, task, impact. Fuller's work was the base upon which CBAM research on Stages of Concern was built. A result of this research is the reaffirmation that not only do teachers go through a sequence of concerns about teaching, but all teachers faced with a new program or innovation have concerns that are identifiable and developmental and are similar to those documented by Fuller. From this research on change, seven Stages of Concern About the Innovation have been identified (Figure 1).

Stages of Concern About the Innovation (SoC), describes the kinds of concerns which the individual may experience across time, related to the innovation. They range from initial self concerns (Stages 1 & 2), "In what ways will

Figure 1

STAGES OF CONCERN ABOUT THE INNOVATION*

	STAGES OF CONCERN	DEFINITIONS
IMPACT	6 REFOCUSING	The focus is on exploration of more universal benefits from the innovation, including the possibility of major changes or replacement with a more powerful alternative. Individual has definite ideas about alternatives to the proposed or existing form of the innovation.
IMPACT	5 COLLABORATION	The focus is on coordination and cooperation with others regarding use of the innovation.
IMPACT	4 CONSEQUENCE	Attention focuses on impact of the innovation on student in his/her immediate sphere of influence. The focus is on relevance of the innovation for students, evaluation of student outcomes, including performance and competencies, and changes needed to increase student outcomes.
TASK	3 MANAGEMENT	Attention is focused on the processes and tasks of using the innovation and the best use of information and resources. Issues related to efficiency, organizing, managing, scheduling, and time demands are utmost.
SELF	2 PERSONAL	Individual is uncertain about the demands of the innovation, his/her inadequacy to meet those demands, and his/her role with the innovation. This includes analysis of his/her role in relation to the reward structure of the organization, decision making, and consideration of potential conflicts with existing structures or personal commitment. Financial or status implications of the program for self and colleagues may also be reflected.
SELF	1 INFORMATIONAL	A general awareness of the innovation and interest in learning more detail about it is indicated. The person seems to be unworried about himself/herself in relation to the innovation. She/he is interested in substantive aspects of the innovation in a selfless manner such as general characteristics, effects, and requirements for use.
SELF	0 AWARENESS	Little concern about or involvement with the innovation is indicated.

*Original concept from G. E. Hall, R. C. Wallace, Jr., & W. A. Dossett, A Developmental Conceptualization of the Adoption Process within Educational Institutions (Austin, Tex.: Research and Development Center for Teacher Education, The University of Texas, 1973).

I be affected by this innovation?"; to concerns related to task (Stage 3), "How can I make this innovation work?"; and then to concerns for impact (Stages 4, 5, & 6), "How will using this innovation affect my students?" Individuals experience a variety of concerns at any one time; however, the degree of intensity of different concerns will vary depending on the individual's knowledge and experience.

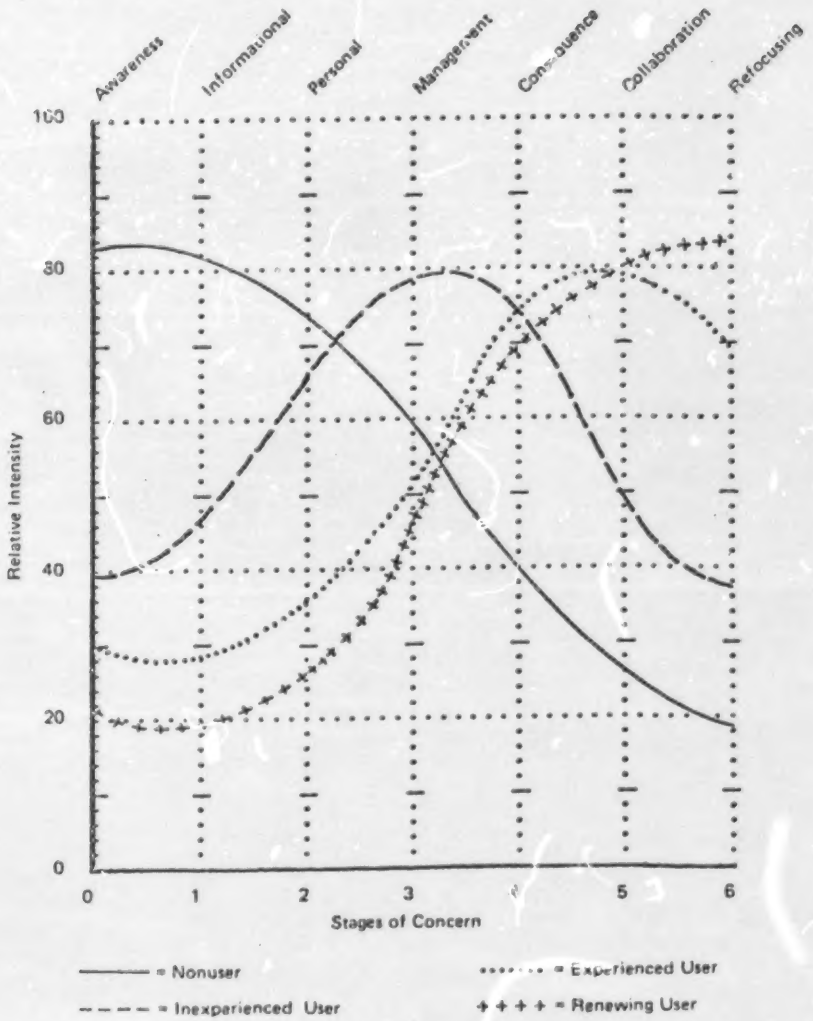
Thus, teachers seldom have concerns at only one stage. Figure 2 illustrates that teachers who are nonusers of an innovation typically will have concerns high on Stages 0, 1 and 2. They are more concerned about gaining information (Stage 1) or how using the innovation will affect them personally (Stage 2). As they begin to use an innovation, Stage 3 Management concerns become higher and more intense. And, when teachers become experienced and skilled with an innovation, the tendency is for concerns at Stages 4, 5, and 6 to become more intense with decrease in Stages 0, 1, 2 and 3 (Hall, George & Rutherford, 1977).

To measure the seven Stages of Concern, the Stage of Concern About the Innovation Questionnaire (SoCQ) (Hall, George & Rutherford, 1977) is used. This psychometrically rigorous paper and pencil measure is especially important for research and program evaluation and consists of 35 items. Teachers respond by indicating their degree of concern on a Likert scale for each of the items. Scoring these data by computer program, or manually, results in percentile scores and a profile of concerns for the individual, or for groups.

Environmental Education Questionnaire. Teachers' attitudes toward environmental science education were assessed through use of the Environmental Education Questionnaire (EEQ) instrument (Jaus, 1978). Attitude is defined as a predisposition to respond favorably or unfavorably toward an object, concept, or idea. In other words, a person may respond toward the concept "environmental

Figure 2

Hypothesized Development of Stages of Concern



science education" in a favorable, neutral, or unfavorable manner. The EEQ measures a person's attitude or predisposition toward environmental science education with a score between 20 and 100 (very positive). A score of 60 would indicate a neutral attitude toward environmental education. Thus movement toward the high end of the scale would indicate a more pronounced positive attitude while movement toward the low end would indicate an increasingly negative attitude.

The instrument includes a five category Likert-type scale with responses from "strongly agree" to "strongly disagree." Jaus (1978) used the test-retest method to report the reliability of the instrument. An alpha reliability of .89 was found for the combined groups on the pretest in this present study. The content validity of EEQ was established in the initial study by Jaus (1978). A total of 78 items were submitted to five science education professors and two social sciences professors. The judges were asked to rank statements, suggestions, and/or positive attitudes toward environmental science education. The original item pool (78) was reduced to those statements receiving perfect agreement among the judges. This resulted in a final instrument containing 20 items.

Assessment Procedures

The staff development research study was designed so that data would be collected at three points: pre-training, mid-way (16 weeks), and post-training (32 weeks). In addition to collecting data from the sample of teachers in the treatment group, a control group was established, from whom attitude data would be obtained for comparison purposes.

In order to minimize error variance between groups related to systematic differences among individual teachers within the two samples, the control group

was generated from subjects paired with the treatment group subjects. Each participant was requested to select a teaching colleague in the same grade within their school. These subjects served as the control group. Because of the similar context it was hypothesized that the control group's situation and experiences would approximate that of the participants.

RESULTS OF THE STUDY

As indicated, data were collected using the concerns (SoCQ) instrument with the treatment group, and the attitude (EEQ) instrument with both the treatment and control groups. Comparisons of the two groups' attitude scores were made at the beginning of the program, at the conclusion of 16 weeks (mid-way), and at the end of 32 weeks (post-test). Comparison was also made of the treatment group's pre-, mid-, and post-SoCQ data.

Findings from EEQ

Comparisons between the pre-test means of the control and treatment groups of the EEQ instrument were calculated to identify any significant differences between the groups prior to the treatment (Table 1). An analysis of variance (ANOVA) was performed on the data using the statistical package in social sciences (SPSS, 1975). There were no significant differences at the pre-training point between the group means for the EEQ at $p \leq .05$ level of significance. Noting the pre-test scores of 78 50 for the control group and 83.32 for the experimental group, the difference in these baseline data could be considered. One explanation might be the interest in science shown by the experimental group's volunteering for the treatment, or inservice. This hypothesis would suggest that the treatment group would come to the study with higher or more positive attitudes about science.

TABLE 1

GROUP MEANS ON THE EEQ (PRE-TEST)

Control	Experimental
78.50	83.32

At the end of 16 class sessions comparisons between the means of the two groups were calculated for the EEQ instrument. Significant differences were found between the group means for the EEQ (Tables 2 & 3).

TABLE 2

GROUP MEANS ON THE EEQ (16th WEEK)

Control	Experimental
76.48	86.51

TABLE 3

ANOVA OF EEQ (16th WEEK)

Mid-test for the Control and Treatment Groups

Source	SS	DF	MS	F
Main effect	1468.35	1	1466.35	25.61*
Residual	3324.98	58	57.33	
TOTAL	4793.33	59	81.24	

*$p \leq .05$

Thus the treatment group did differ from the control group significantly after 16 weeks in the program. As can be seen in TABLE 2 the group means for the treatment group did increase significantly during the first 16 weeks.

Comparison between the means of the two groups at the end of 32 class sessions were calculated for the EEQ instrument. Significant differences were found between group means for the EEQ. This was significant at the $p \leq .05$ level (Tables 4 & 5).

TABLE 4

GROUP MEANS ON THE EEQ (32nd WEEK)

Control	Experimental
78.43	88.97

TABLE 5

ANOVA OF EEQ (32nd WEEK)

Post-test for the Control and Treatment Groups

Source	SS	DF	MS	F
Main effect	1341.71	1	1341.71	22.67*
Residual	2959.60	50	59.19	
TOTAL	4301.31	51	84.34	

*$p \leq .05$

A review of TABLE 4 indicates that the difference occurred in favor of the treatment group as compared to the control group. Thus, there was continued increase in score over the second 16 weeks in the treatment group. A review of the means in TABLE 1, 2, and 4 reveals a continuous improvement in the treatment group over the entire course of the program (32 weeks). This is a contrast to the drop in score for the control group at the 16th week. Though the control group score rose after 32 weeks to 78.43, it did not reach the original score of 78.50 expressed in September.

Findings from SoCQ

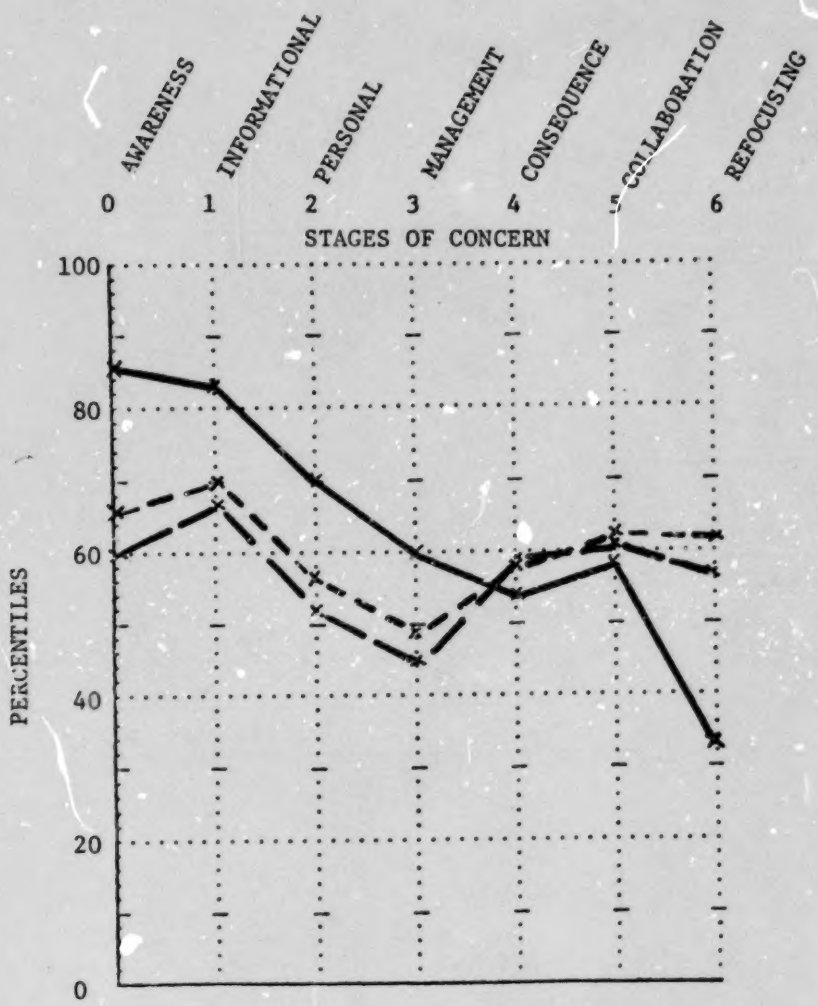
In this section, the composite profiles of the treatment group are reviewed and discussed. In addition, the individual profiles of two teachers are examined and interpreted. The teachers' concerns were observed to change during the course of the program.

Treatment group. The treatment group concerns profiles are found in Figure 3. The three profiles are exhibits of the group concerns expressed before, at mid-point and at the conclusion of the sixteen week program. The pre-program data present a typical "nonuser" profile. The most intense concerns of these teachers in September before the inservice program began were Stage 0 Awareness, Stage 1 Information, and Stage 2 Personal. Informed speculation about the high Stage 0 score would suggest that participants knew very little about the program and were generally "unaware" of its content, goals, etc. The scale score on Stage 1 was higher than on Stage 2, indicating that teachers were more interested in obtaining information about the program than they were concerned about their personal selves related to the training program. Such a profile typically indicates readiness and openness to learning new knowledge and skills without undue threat or anxiety. The lesser peaking on Stage 5 Collaboration concerns would reflect interest in working with others. This was a desired characteristic, since these teachers would be expected to work with other teachers.

In February, and in May, the profiles indicate substantial and continuing decreases on Stages 0, 1, 2 and 3, the "self and task" concerns. The February and May profiles are nearly congruent on Stages 4 Consequence and 5 Collaboration and reflect a slight elevation in intensity of concerns on these "impact" stages. This trend was noted as a positive outcome. At this time teachers would have had a small amount of experience in their classrooms using their new science knowledge and instructional skills. The increased Stage 5 concerns were reinforced by activities of helping the teachers plan for and implement a training session in environmental science education with their "at home" teacher colleagues. The increase in intensity of Stage 6 from September to February and continuing upward a bit in May suggests that teachers had ideas about additional methods for improving their science instruction for students.

Figure 3

Group Profiles of all Treatment Subjects



September _____ (N = 44)

February - - - - - - - - (N = 39)

May __ __ __ (N = 33)

A review of individual teacher profiles provided useful information which aided planners in decision-making about training. These individual profiles also revealed the effectiveness of the training program in changing teacher concerns about the environmental science education program. Two examples are provided in the following case studies.

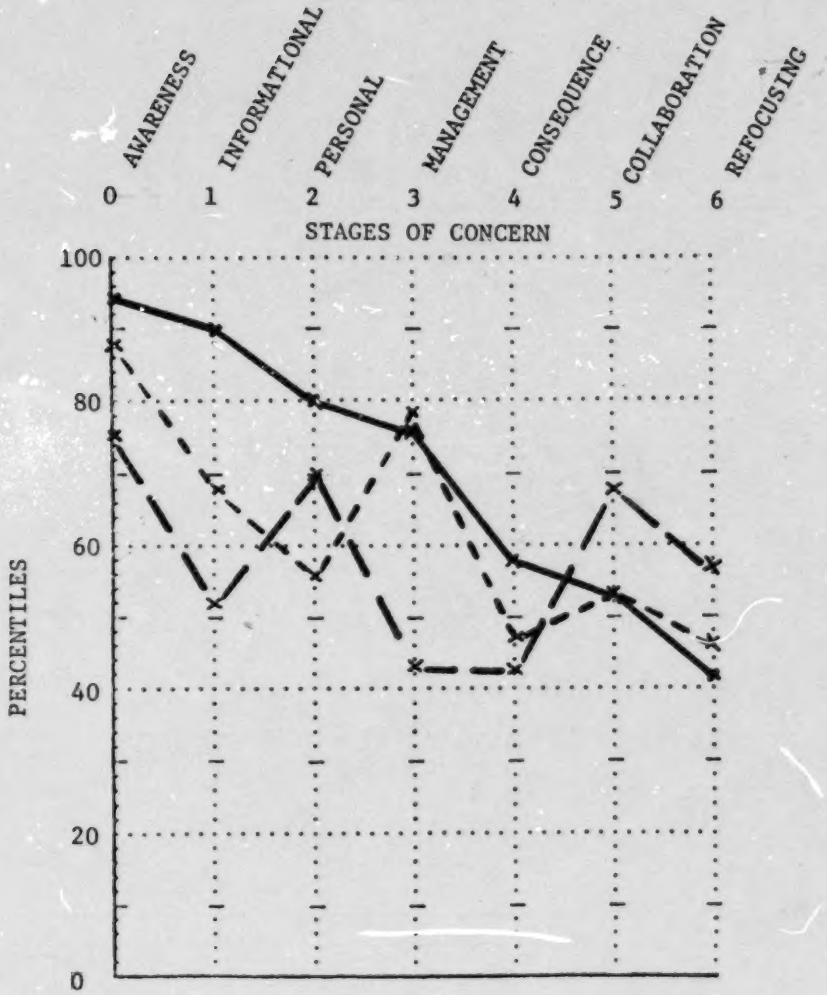
Teacher B. The pre-, mid- and post-program profiles of Teacher B are exhibited in Figure 4. This teacher began the program with high Stage 0, 1, 2 and 3 concerns and low Stage 4, 5, 6 concerns. This profile is generally consistent with the total group profile, though higher on Stage 3 Management. The high Management concerns before the training began indicate a teacher who probably is already thinking ahead to how she will integrate new knowledge, skills and activities into the instructional day, which likely is already quite a full one.

At the mid-point data collection, her profile indicates continuing high Management concerns, but Stage 1 Information and Stage 2 Personal concerns have dropped appreciably. This would suggest that Teacher B has received sufficient information and/or support or reinforcement to alleviate personal concerns. The what/when/where/how- to-do its of envirnomental science in the classroom are the focus of interest and attention.

At the end of the program, the profile shows continuing decrease in concern for information and dramatic decrease in the management concerns indicated in the two previous profiles. Teacher B's impact concern is definitely focused in the Collaboration stage while the "twin peak" on Stage 2 reveals personal concerns. A double peaking of Personal/Collaboration is understandable in view of new responsibilities for facilitating others in their training and use of innovations. Follow-up activities designed to aid this teacher in working with

Figure 4

Teacher B Concerns Profiles



others and acquiring experience would hopefully resolve the high Personal concerns.

Teacher H. Figure 5 presents the results of SoCQ data collected from Teacher H. High concerns on Stages 0, 1, and 2 are underscored by very low Stage 3 Management concerns--which remain low through the program. One might speculate, based on the low Management concerns and consistently higher impact concerns of Stages 4 and 5, that this teacher is a good organizer and is seldom troubled by logistical considerations.

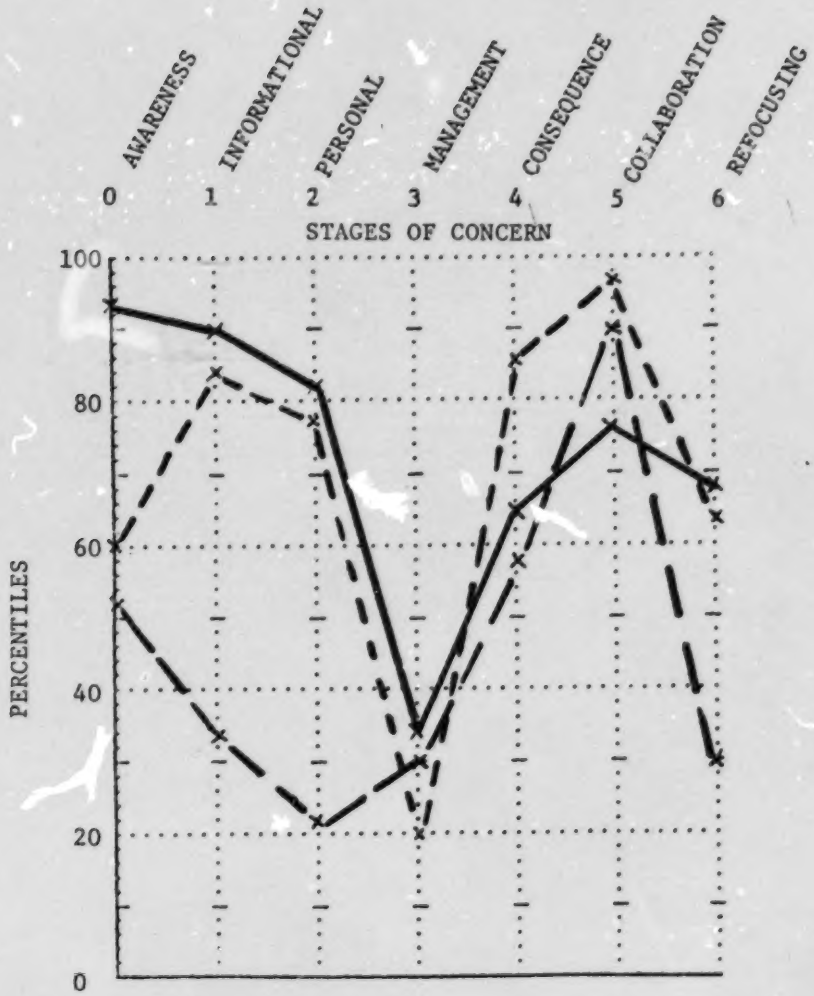
Like many of the teachers at the program's mid-point, Teacher H remained high on Information and Personal concerns. At this period in the program a concerted effort was undertaken by the director to explore and discover the nature of the concern for information and then to provide program activities to respond appropriately. For Teacher H, these interventions appear to have been highly successful, as evidenced by the great decrease in Stages 0, 1 and 2 concerns at the program's end.

On the "impact" stages at the mid-point, Teacher H's concerns rose in intensity on Consequence and Collaboration while remaining essentially the same for Refocusing. At the conclusion of the inservice training in May the profile represents a sharp intensity of concern on Collaboration, working with others to influence student learning, with lower concerns for Consequence, or working more individually to impact student gains. The drop in Refocusing concerns could be construed as a gain in satisfaction with the program or the elimination of interest in looking for additions or replacements for the environmental science education program.

In summary, the results of the staff development research study reveal that the attitudes of the group of inservice teachers changed significantly as compared to a set of control group teachers. The inservice teachers' concerns

Figure 5

Teacher H Concerns Profiles



September _____ (N = 1)

February -------- (N = 1)

May _ _ _ _ (N = 1)

changed substantially over the course of the staff development program. The SoCQ and EEQ proved to be useful instruments for identifying change in teachers in a specific and definite manner.

IMPLICATIONS AND IMPORTANCE TO INSERVICE

The data collected in this study recognized and verified the need for staff development programs which are designed to address "where teachers are," in terms of their expressed needs for teaching science and in terms of their concerns and attitudes toward new or innovative programs. Further, the results verified the value and effectiveness of such inservice programs in environmental science.

In the past, the lack of appropriate diagnostic tools made the delivery of relevant staff development difficult. The instruments used and applied in this study overcame this vexing problem. In addition, the results of the study could be used as a measure of the effectiveness of an inservice program which had been implemented through utilization of quantitative data collected on teachers' concerns and attitudes during the term of the inservice program.

Change takes time. Staff developers who are responsible for inservice need to plan on a spread of training and other activities over time and paced in relationship to the concerns of teachers. A "one-shot" workshop is not likely to respond to the ongoing needs teachers have, reflected by their changing concerns as they become first knowledgeable about and then users of a program or practice. Change does take time. The more complex or complicated, the more time is required.

Change is a personal experience. Depending on many factors, the concerns of individual teachers will vary. Staff developers can use Stages of Concern to help in diagnosing, planning, delivering, and assessing activities which will be

relevant and address teachers' concerns. For example, teachers with high Management concerns about their science program will not respond very positively to suggestions about individualizing the lessons for increased impact on student learning.

Continuing reviews of the inservice teachers' responses on the SoC instrument were made in order to plan the materials and activities for the environmental science education program. It guided the planners in choosing teaching techniques and activities that would provide teachers with knowledge about what environmental science is, its general nature, and the major topics related to environmental science, thereby responding to their high Informational concerns. Laboratory activities were designed to enhance these topics and provide teachers with "hands-on" experiences to increase their understanding. As a formative evaluation device the SoC data were very useful in monitoring the program and for making decisions about possible modifications in the program, program support and training.

One of these decisions came after reviewing the SoCQ data collected at midpoint (16 weeks). The data were studied carefully for each individual and as a result training was now conducted in a more personalized small group format (two to three participants at one time) to respond to individual's needs. In addition, emphasis was placed on activities directed to the upper levels of the SoC scale (Consequence and Collaboration stages) as well as environmental science concepts.

During a year-long training program teachers predictably will express differential concerns and attitudes. In the example presented here teachers did significantly change in their concerns and attitudes toward environmental science. This change continued over a long period of time (nine months). Teachers with positive attitudes toward science will tend to teach science and

more than will teachers who have negative attitudes. This is an obvious statement. This study, however, shows that positive attitudes about teaching science can be significantly increased.

FUTURE STUDIES AND ADDITIONAL NEEDS

As a follow-up to the present study a careful review of the scope of science and length of time it is taught on a daily basis needs to be determined. It is therefore important to do a follow-up survey of science teaching by the program participants. Additional strategies and procedures might be identified which could better ascertain how teachers are using the ideas and concepts developed and presented in the program.

Further alterations of the training program to better meet the expressed needs of the teacher should be considered. A research design to provide relevant data will be needed. For instance, a content test might be included at the beginning and at the conclusion of the program. In future training programs monthly feedback forms should be used in order to fine-tune the program content for the participants.

There are indeed other refinements that may be made if funding is available. The results presented here will be carefully utilized for the improvement and the delivery of inservice education to teachers in the central Texas region.

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